

Task: Make a plan of the article below using key words

Influence of crown height space in cases of detachment of the implant supported fixed partial dentures: Retrospective clinical study.

Retaining of the fixed implant supported restorations is accomplished in several ways – by means of adhesion (cementing), screwing or by a combination of both (1). Their advantages and disadvantages as well as their influence on the frequency of mechanical and biological complications (2, 3) have been widely discussed in scientific literature.

Mechanical complications in fixed implant-supported prostheses can be difficult to correct, particularly when they are permanently cemented. Loss of retention between the abutment and prosthetic restoration is one of the most common complication associated with the long-term function of fixed implant restorations.

The results of the detachment researches of fixed implant prostheses are heterogeneous and show a frequency of such complication from 2.0 to 12.5% within the first 5 years. The risk of loss of retention after the fifth year increases to 23.72% (4-8).

For the construction of the fixed implant supported restorations having high aesthetic and functional characteristics, the height of the restorative space is supposed to be within optimal range. It has been found out that the most favourable height for making fixed implant restorations is between 8 and 12 mm (9, 10). This has an influence on the stability of such restorations for the years to come. The loss of adhesive retention is most often established when the height of prosthetic restoration is less than 6 mm (11, 12). In such cases the shorter abutment cannot provide adequate retention of prosthetic restorations (13).

On the other hand, the type of restoration has a significant impact on the onset of detachment in fixed implant supported restorations. Data from the studies of Clelland N et al. and of Pellizzer EP et al. shows that the incidence of mechanical complications is lower in making dentures with splinted crowns compared to those with single crowns under similar other conditions (14, 15).

According to other authors, the use of splinted crowns leads to a reduced incidence of failed implant treatment (16).

The biomechanical impact analyses in the study of bridges of the implant - natural tooth type are contradictory. The occurrence of mechanical complications is more often described, and the detachment of the fixed prosthesis turns out to be most frequent among them (17-20).

The aim of this study was to determine the influence of the crown height space on the loss of retention in different types of implant-supported Fixed Partial Dentures (FPD).

Material and method

In the present study, 116 patients being partially edentulous regarding upper and lower jaws - 63 women and 55 men were followed retrospectively. The treatment was performed with fixed restorations on 261 implant supports. Two-stage late implantation was used following open surgical procedures (Fig 1-1 and Fig 1-2). The age of the study group is from 15 to 78 years. The dental implants were exposed after 4 months of implantation in the lower jaw and after 6 months in the upper jaw (Fig 2-1 and Fig 2-2).

The following indicators have been traced out:

- Implantation area;
- Type of fixed restorations: single crowns, splinted crowns, bridge implant - implant, bridge implant - natural tooth;
- Crown height space;
- Decementation of FDP

All implants have been performed after a preliminary occlusal analysis, including examination of the occlusal scheme, teeth eruption, crown height space as well as inter-tooth and maxillomandibular relations. Reporting the volume available bone was determined by CT scans made in a central occlusion. The following equipment was applied - Planmeka Promax 3D (Planmeca Oy, Asentajankatu 6, FIN-00880 Helsinki, Finland). The crown height space was measured at the selected implant sites on the paraxial slices. The open-source software ImageJ 1.52i (National Institutes of Health, Bethesda, Maryland, USA) was used. The distance from the crestal bone of the alveolar ridge to the functional tubercles of the antagonist teeth was reported (Fig 3).

All restorations have been fixed with polymer polyacryl-urethane cement - (Dentotemp, Itena, 153, Victor Hugo Ave, 75116, Paris, France).

Postoperative checkups were performed respectively in the 1st, 3rd and 6th months, then once a year. An evaluation of the prosthesis restorations condition was carried out: cracks traces, porcelain fractures, detachment and presence of micromobility. In cases of prosthetic restorations detachment, they were re-cemented with glass ionomer cement - Ketac Cem Plus (3M ESPE AG, ESPE Platz, 82229 Seefeld,) Germany (21).

The results statistical processing is consistent with the nature of the data and the nature of the phenomena being traced. Most of the indicators have no normal distribution, which necessitated the use of nonparametric methods of analysis. Descriptive methods of categorical and quantitative variables (mean, median, mode, standard deviation, minimum and maximum), cross tabulations, as well as hypothesis testing methods have been applied (Kolmogorov-Smirnov, Mann-Whitney and Kruskal-Wallis). Data processing was done with IBM SPSS Statistic 20 (Armonk, NY, 10504-1722, USA).

Results

The results are based on data recorded by clinical examinations and software measurements. It is assumed for a zero hypothesis (H_0), that the crown height space does not affect the detachment of the adhesive retention between the implant platform and fixed prosthetic restorations.

In order to gain clear processing and results interpretation, we combined the data in relation to the implantation areas into six groups: maxillary molars, maxillary premolars, maxillary anterior teeth, mandibular anterior teeth, mandibular premolars and mandibular molars. The implants distribution according to the place of implantation is as follows: maxillary molars -32 (12.3%), maxillary premolars - 48 (18.4%), maxillary anterior teeth - 35 (13.4%), mandibular anterior teeth - 20 (7.7%), mandibular premolars - 29 (11.1%) and mandibular molars - 97 (37.2%).

– Type of prosthetic restoration. Single crowns were made in 112 (42.9%) implants, splinted crowns in 51 (19.5%), bridge “implant – implant” in 62 (23.8%) - and bridge “implant - natural tooth” in 36 (13.8%). Their retention was accomplished by cementation in all 261 cases.

– Crown height space. The data are summarized in several groups according to those accepted in scientific literature (22): insufficient restorative space - less than 6 mm, minimum - from 6 to 8 mm, optimally - from 8 to 12 mm, large - from 12 to 15 mm as well as cases with a height of more than 15 mm. The minimum reading value

is 5.37 mm, the maximum is 18 mm and mean – 10.786 at a standard deviation 2.987. The frequency of the analyzed cases has been presented in Table 1.

– Prosthesis detachment. This complication was found out in 5.7% of all follow-up cases. Figure 4 points out the distribution of cases with and without detachment depending on crown height space.

Regarding implant sites, data show that the most common adhesive bond loss of retention has been observed in the lower molar area (73.33% of all cases). Kruskal-Wallis test is usually used to check whether there are differences between groups. Statistically significant differences were ascertained depending on the site of implants performed and the detachment of prosthetic restoration - $\chi^2(5) = 11.110$, $p = 0.049$.

The influence of the FPD type, at the onset of such complication was followed by Kruskal-Wallis test. The data show that there are statistically significant differences between various types of prosthetic restorations - $\chi^2(4) = 8.147$, $p = 0.004$. The most common detachment was found to be in single crowns - 12 cases, followed by splinted crowns - 2, prosthesis in bridges of "implant - natural tooth" type - one case and never in bridges of the "implant – implant" type.

The influence of the crown height space on the loss of retention of the prosthetic restorations has been studied by Mann-Whitney test. The data revealed statistically significant differences between different groups: with detachment (mean rank 134.68) and those without (mean rank 70.70), $U = 940.500$, $p < .0001$. In Table 2 *it is presented* their distribution depending on the crown height space and type of implant supported restorations.

The data in Table 2 show that the incidence of detachment of the FDP increases while the crown height space decreases.

In the cases of detached restorations and replacement of cement with such of higher retention resistance, we recorded a new detachment in only three cases, after a period of 8 to 12 months. All of them were with single crown restorations and limited restorative space - below 6.0 mm. The definitive resolution to the arisen complication has been reached by making new screw-retained crowns.

Discussion

The data from the conducted analyses give us reason to assume that the crown height space has a direct influence upon the detachment occurrence of the

implant supported FDP. On such grounds we may reject the zero hypothesis (H_0) and accept alternative one.

The results of this study show that increased incidence of detachment of implant-supported fixed partial dentures has been observed in crown height space below 8.0 mm (Fig 4). These data are similar to those depicted in other studies tracking the influence of this factor in cases of impaired retention of FPDs (23, 24). The studies of Abbo B. et al. indicate that decreasing the abutment height by 1 mm significantly reduces the retention of the prosthetic restoration (25). This tendency is most pronounced when the crown height space is below 6 mm and combined with the use of single crowns. Our data are in agreement with the research carried out by Rödiger et al. (26) where the influence of the abutment height and inclination over the detachment of the prosthetic restoration is monitored. The published data reveal that these two variables directly impacted long-term retention, regardless of the type of cement used - temporary or permanent (26).

On the other hand, the use of abutments with larger diameter can significantly improve the retention of fixed restorations at a reduced height (27). This approach cannot always be applied in clinical practice due to the anatomical constraints in the implantation area with respect to the available width, length and natural alveolar bone inclination.

A significantly lower incidence of detachment of restorations with splinted crowns has been reported in conditions of reduced crown height space. Such data are consistent with the published data from the studies of Clelland N et al. (14) as well as Pellizzer EP et al. (28) showing that the incidence of biomechanical complications is lower in splinted crown prostheses compared to prosthetic restorations with similar single crowns under analogous other conditions. In this study, it may be assumed that the splinted crowns favour the distribution of functional stress by reducing stress in the area of the crest module and abutment, which is supported by the results of similar research (29).

The analysis of short and long-term studies showed fewer failures in adhesive retention of the fixed implant supported restorations compared to screw retained (1). However, in case of a new loss of retention under conditions of reduced crown height space - less than 6 mm, making a new screw retained prosthesis restoration turns out to be a good alternative.

Surface treatment of abutments by creating retention grooves or increasing the contact surface of abutment by means of sandblasting creates conditions to

improve the retention of the prosthetic restoration (30). These methods are most effective when applied with a simultaneous increase of the abutment height and the use of reinforced cements (31).

Conclusion

Although the data in the present study are limited, the results suggest that the reduced crown height space is a prerequisite for detachment of the implant supported FPDs. In such situations, the possibilities of subcrestal positioning of the implant platform and the use of abutments with minimal gingival height should be considered at the planning stage of prosthetic restoration. With this approach, there is a possibility of achieving improved retention due to the increased height of the implant abutment. If subcrestal implantation is impossible and the crown height space is below 6.0 mm, an alternative approach is to use a screw-retained FPDs.

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